

## WHAT IS CLAIMED IS:

1. A gas turbine engine combustor element comprising:  
a trapped dual vortex cavity defined between an aft wall, a forward wall, a bottom  
5 wall formed therebetween, and a cavity opening at a top of said cavity spaced apart from  
said bottom wall and extending between said aft wall and said forward wall;  
air injection first holes in said forward wall positioned close to said bottom wall;  
air injection second holes in said aft wall positioned approximately midway between  
said bottom wall and said opening at said top of said cavity; and  
10 fuel injection holes in said forward wall and located between said air injection  
second holes and said bottom wall.
2. An element as claimed in claim 1, further comprising first angled film cooling  
apertures in said bottom wall angled away from said forward wall.
- 15 3. An element as claimed in claim 2, further comprising second angled film cooling  
apertures located in said forward wall between said fuel injection holes and said bottom  
wall and angled towards said bottom wall and third angled film cooling apertures located in  
said forward wall between said fuel injection holes and said opening and angled towards  
20 said opening.
4. An element as claimed in claim 3, further comprising top and bottom film cooling  
slots parallel to said aft wall and operable to flow and direct cooling air along said aft wall.
- 25 5. An element as claimed as claimed in claim 1, wherein said fuel injection holes, air  
injection first holes, and air injection second holes, are singularly arranged in circumferential  
rows.

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12. A liner as claimed in claim 11, wherein said fuel injection holes, air injection first holes, and air injection second holes, are singularly arranged in circumferential rows.

14. A liner as claimed in claim 13, further comprising a top film cooling slot parallel to said aft wall and operable to flow and direct cooling air along said aft wall and a bottom wall cooling slot extending from said forward wall, parallel to said bottom wall, and operable to direct and flow cooling air along said bottom wall.

15. A gas turbine engine combustor comprising:  
an outer liner;  
an inner liner spaced from said outer liner, wherein a combustion chamber is defined therebetween;

a dome inlet module having an outer member fixed to said outer liner and an inner member fixed to said inner liner, wherein a plurality of flow passages are defined therebetween for flowing air into said combustion chamber;

means for injecting fuel into said flow passage;

a trapped double vortex outer cavity in said-outer liner and positioned immediately downstream of said dome inlet module;

said trapped dual vortex outer cavity defined between an aft wall, a forward wall, a bottom wall formed therebetween, and a cavity opening at a top of said cavity spaced apart from said bottom wall and extending between said aft wall and said forward wall;

an outer plurality of air injection first holes in said forward wall positioned close to said bottom wall;

an outer plurality of air injection second holes in said aft wall positioned lengthwise approximately midway between said bottom wall and said opening at said top of said outer cavity;

an outer plurality of fuel injection holes in said forward wall between said outer plurality of air injection second holes and said bottom wall;

means for injecting fuel into said outer plurality of fuel injection holes; and

an igniter positioned adjacent to said trapped vortex cavity for igniting said fuel and air therein to produce pilot combustion gases.

16. A gas turbine engine combustor as claimed in claim 15, further comprising:

a trapped double vortex inner cavity in said inner liner and positioned immediately downstream of said dome inlet module;

said trapped dual vortex inner cavity defined between a second aft wall, a second forward wall, a second bottom wall formed therebetween, and a second cavity opening at a second top of said inner cavity spaced apart from said second bottom wall and extending between said second aft wall and said second forward wall;

an inner plurality of air injection first holes in said forward wall positioned close to said bottom wall;

an inner plurality of air injection second holes in said aft wall positioned lengthwise approximately midway between said bottom wall and said opening at said top of said inner cavity;

an inner plurality of fuel injection holes in said second forward wall between said inner plurality of air injection second holes and second said bottom wall; and

means for injecting fuel into said inner pluralities of fuel injection holes.

17. A gas turbine engine combustor as claimed in claim 16, wherein said means for injecting fuel comprises a plurality of fuel injector bars positioned circumferentially around and interfacing with said inlet dome module, each of said fuel injector bars in flow communication with a fuel supply and comprising:

a body portion having an upstream end, a downstream end, and a pair of sides;

a first plurality of injectors located in said body portion and in flow communication with said fuel supply;

radially outer and inner fuel injectors located in said body downstream end and in flow communication with said fuel supply; and

5        said outer and inner fuel injectors aligned and open to said outer and inner plurality of fuel injection holes, respectively.

18.     A gas turbine engine combustor as claimed in claim 17, further comprising first angled film cooling apertures in said bottom walls angled away from said forward walls.

10        19.     A gas turbine engine combustor as claimed in claim 18, further comprising second angled film cooling apertures located in said forward walls between said fuel injection holes and said bottom walls and angled towards said bottom wall and third angled film cooling apertures located in said forward walls between said fuel injection holes and said openings  
15        and angled towards said openings.

20.     A gas turbine engine combustor as claimed in claim 19, wherein said fuel injection holes are wider than said downstream end of said fuel injector bars to allow combustion air to flow around said fuel injector bars and through said fuel injection holes.

20        21.     A gas turbine engine combustor as claimed in claim 19, further comprising top and bottom film cooling slots parallel to said aft wall and operable to flow and direct cooling air along said aft walls.

25        22.     A gas turbine engine combustor as claimed in claim 19, wherein said fuel injection holes, air injection first holes, and air injection second holes, are singularly arranged in circumferential rows.

23.     A gas turbine engine combustor as claimed in claim 19, further comprising an  
30        annular outer vane, an annular inner vane, and one or more annular middle vanes disposed



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